

## **Northeast Coastal and Barrier Network GIS Contract Specifications**

These GIS contract specifications were developed by Nigel Shaw, GIS Field Technical Support Center of the Boston Support Office (version 4, 2004Sept25). The purpose of these specifications are to provide NCBN personnel, contractors and cooperators with guidance for acquiring new data.

### **I. Deliverables**

Two copies of complete and verified data will be delivered via CD-ROM (preferred) and/or by software compressed (zipped) file. All digital and hardcopy data and information that is part of the project must be delivered, including GIS data reports, metadata, photos, and other supporting materials. Each CD should be in CDR format, so that once it is written it cannot be modified. The CD should be in ISO 9660 format to allow cross-platform use (this requires 8.3 file names). The products delivered to NCBN data management staff will contain the following items:

#### **A. Required**

- Descriptive document
- Spatial data
- Associated data table(s) or relational MS Access Database
- FGDC-compliant Metadata
- ArcView 3.x Legend (.AVL file) (if appropriate)

#### **B. As Specified**

- GIS Theme Manager Theme Lists
- Linked document(s)
- Linked graphics or digital photographs

### **II. Descriptive Document**

A Microsoft Word document (and/or ASCII text file, if specified) describing the data set will accompany any submission and provide all necessary information for understanding the submittal. This includes but is not limited to the following:

- Contents of the CD or .zip file
- Version and date of the data
- Sensitive data issues (if any exist)
- Accuracy assessment procedures applied
- Recommended "official" theme name
- Contact information for those responsible for the data
- Easily readable data dictionary for all attribute and database tables (i.e. reformatted for readability)
- Linking fields (to documents, MS Access database, digital photographs)
- Viewing scale thresholds (if applicable)

### **III. Spatial Data**

There are several ways in which spatial data can be represented in a GIS including points, lines, polygons or images. Determining which method(s) is appropriate for your study involves consideration of scale and study goals. Prior to data collection, this issue should be addressed and resolved in the project study plan in consultation with the project or data manager. Additionally, network and park data management plans may dictate the appropriate format.

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### A. Naming Conventions

A clear and meaningful filename should be used that conveys the nature of the data and park unit it relates to. File names should adhere to 8.3 naming standards and not contain spaces or special characters. Field names should be 10 characters or less to conform to Dbase and ArcINFO field naming limitations.

### B. Coordinate Systems

All spatial data collected or submitted for NCBN shall be geo-referenced and provided in a standard projection. Digital geospatial data should be referenced to two coordinate systems--the regional-scale system (generally Geographic, NAD83) and the current standard system used by the individual park (generally UTM, NAD83). The steps used to get the data into the proper projection must be documented in the metadata. The Network must specify and approve any deviation from these projection standards.

**i. NPS-wide and Regional Data Standard:** The standard projection for most NPS regions and national programs is geographic (latitude/longitude) with the following parameters:

• <b>Datum</b>	North American Datum 1983
• <b>Spheroid</b>	GRS 1980
• <b>Units</b>	Decimal degrees

**ii. Park Unit Data Standard:** The standard projection for most NPS regions and national programs when the data concerns an individual park is Universal Transverse Mercator with the following parameters:

• <b>Projection</b>	Universal Transverse Mercator (in correct or dominant zone for the park)
• <b>Datum</b>	North American Datum 1983
• <b>Spheroid</b>	GRS 1980
• <b>False Easting</b>	500,000
• <b>False Northing</b>	0
• <b>Units</b>	Meters

### C. Spatial Data Formats

All vector data will be supplied as an ArcINFO coverage, ArcINFO interchange file (\*.E00) and/or ArcView Shape file, compatible with the current version of ArcINFO. All raster data will be supplied as an ArcINFO GRID and ArcINFO interchange file, compatible with the current version of ArcINFO. All digital imagery, such as scanned aerial photographs, is to be supplied as tagged image file format (.TIFF) files with the proper header file (or world file) for geo-referencing purposes. If special circumstances exist, other spatial data formats may be acceptable. If not specified directly in the contract or project proposal, the data format(s) should be clearly stipulated and agreed upon with contractors or cooperators before data collection and processing start. If there are questions about choosing a data format, converting between formats, or non-standard formats, contact the network data manager.

Once the data are produced, appropriate ArcView legends and/or NPS GIS Theme Manager theme list files (see <http://science.nature.nps.gov/im/apps/thmmgr/index.htm>) should be developed and included with the deliverables as specified for the project. Brief reviews of current spatial data formats are listed below.

**i. ESRI ArcINFO Coverage** Data developed in ArcINFO coverage format should be exported to an .E00 file (ArcGIS .E00 files should include the metadata .XML file from ArcCatalog). All coverages

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should be created as double precision data sets. If the data set was originally obtained in single precision, convert it to double precision before submitting. The projection properties of the coverage must be defined.

**ii. ESRI ArcView Shape File** Shape file format shall be used only when an ArcINFO coverage does not exist. The shape file format includes at a minimum the .SHP, .DBF, and .SHX files (ArcGIS .SHP files should include the metadata .XML file from ArcCatalog). A .PRJ (projection definition) file is highly recommended as well.

**iii. AutoCAD DXF** This format is NOT recommended, but will be accepted at the discretion of the project manager. If used, the appropriate AutoCAD release .DXF format must be specified and documented.

**iv. ESRI GRID File** This is the preferred format for raster data and particularly useful for images that contain attributes (other than cell values).

**v. GeoTiff v1.0** A raster format with geo-referencing stored in the header of the file.

**vi. Tiff with world file** Tiff files shall be geo-referenced and include the world file (.TFW).

**vii. ERDAS Imagine file** Imagine files shall be geo-referenced. Pyramid files (.RRD) shall be included if available.

**viii. Other possible raster file formats** Those that may be utilized natively as an ArcView theme include .BMP, .BSQ, .BIL, .BIP, ERMapper, IMPELL Bitmaps, Image Catalogs, .JPEG, MrSID, and Sun Rasterfiles. Again, applicable header or world files must be used, and the appropriate project manager(s) must approve any deviation from the preferred standards listed in bold above.

### D. Collection Methods

Several approaches to capturing digital data can be employed including digitizing features from maps or aerial photographs, and GPS (Geographic Position System) collection. The appropriate method should be determined in the study plan and in consultation with the data manager. Criteria for acceptable GPS coordinates should be based on the National Park Service GPS Data Collection Guidelines at [http://www.nps.gov/gis/data\\_standards/DataStandards.html#GPS](http://www.nps.gov/gis/data_standards/DataStandards.html#GPS)

When digitizing features from maps or photographs, the source, scale, date, and methods (i.e., process steps) shall be recorded in the Metadata and discussed in the Descriptive Document. When using GPS collection, the GPS unit type, averaging method, post processing and other criteria shall be recorded in the Metadata and discussed in the Descriptive document.

### E. Scale and Spatial Resolution

**i. Vector Data** New data should not exceed 1:24,000. The contractor should contact the park's GIS Coordinator for specific scale and spatial resolution requirements for vector data or they may be specified in the contract or cooperative agreement. In general contractors and cooperators are strongly encouraged to use park orthophotography as a base for new vector data or for editing GPS linework. Typically data collected for individual parks will be using a scale much larger than the USGS topographic maps (e.g. 1:6,000 would be typical).

**ii. Digital Image Data and Aerial Photography** Specific scale and spatial resolution requirements for image data should be specified in the contract or cooperative agreement, or the contractor should contact the project manager for clarification. For vegetation classification under the NPS/USGS

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vegetation classification and mapping program, the current standard is 1:12,000 color infrared aerial photographs with 60% overlap (endlap) and 30% sidelap.

### F. Horizontal and Vertical Accuracy

All spatial data collected shall be analyzed for their spatial accuracy and shall meet or exceed the National Map Accuracy Standards for the particular scale intended (for more information see <http://geography.usgs.gov/standards/>). Longitude and Latitude coordinates for geographic data should be recorded to a minimum 5 significant digits to the right of the decimal point and stored in double precision attribute or database fields. Any calculations done with location data should be done at double precision with the results rounded or truncated to the appropriate propagated error limits. All calculations and processing completed on the spatial data shall be reported in the metadata.

For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground: monuments or markers, such as benchmarks and property boundary monuments; intersections of roads and railroads; and corners of large buildings or structures (or center points of small buildings). In general, what is well defined will also be determined by what is plot-able on the scale of the map within 1/100 inch. Thus, while the intersection of two roads or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. This class would cover timber lines and soil boundaries.

Vertical accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error by more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale. (USGS Fact Sheet 078-96, 1997)

The following table provides the allowable horizontal accuracy for some common scales:

Scale	Allowable Error	Scale	Allowable Error
• 1:40,000	33.8 meters (111 feet)	• 1:9,600	4.9 meters (16 feet)
• 1:31,680	16.1 meters (53 feet)	• 1:4,800	2.4 meters (8 feet)
• 1:24,000	12.2 meters (40 feet)	• 1:2,400	1.2 meters (4 feet)
• 1:20,000	10.1 meters (33 feet)	• 1:1,200	0.6 meters (2 feet)
• 1:12,000	6.1 meters (20 feet)		

### IV. Attribute Data

By their nature resource inventories and studies will generate complex data sets. All fields within the database supporting GIS layers should have names of 10 characters or less due to ArcView and Dbase limitations. Because the ArcINFO Coverage/Shape file format is not ideal for storage and management of complex relational data, relational attribute data shall be stored in a separate, well-structured relational database system. Map features and database records shall share a common unique identifier or primary key that relates a map feature to a table record.

#### A. Primary Key

The Natural Resource Database Template is a Microsoft Access database that contains the core table “tblLocations” that contains the primary key field “LocationID”. GIS data are required to also contain a field, “LocationID,” and be formatted the same as in the Database Template (type = Character, length = 255). The values of LocationID must be unique and less than 255 characters in length and should be consistent (perhaps based on sampling strategy).

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Actual value domains should be specified in the study plan or after consultation with the park, network, region, or program GIS/data manager(s).

For more information and the data dictionary describing the Natural Resource Database Template see <http://science.nature.nps.gov/im/apps/template/index.htm>.

Other attribute fields may be included in the GIS feature attribute table *if integral to rendering symbology*. These fields will be duplicates of the Microsoft Access data with fields formatted and values consistent with the database fields, and should be refreshed before final delivery of the data set. Any such fields included in the GIS feature attribute table will be detailed in the Descriptive Document.

### **B. Attribute Accuracy**

Every theme may have different tabular attribute data requirements. In general, attribute data entry and quality control should follow good data management practices including verification of precise data entry and validation of possible domain values. All attribute accuracy assessments and corrective actions will be detailed in the descriptive document. Contractors or cooperators should consult with the park, network, region, or program GIS/data manager(s) if guidance is needed about good data management practices. At a minimum, 80% accuracy or greater at a 90% confidence interval is appropriate.

### **IV. Quality Control**

Accuracy assessments of spatial and attribute data should include creation of check plots with spatial features labeled. The Descriptive Document will include the accuracy assessment method(s) performed and scale at which the data were collected. Results of tests used to verify all applicable horizontal, vertical and attribute accuracy measurements will be provided when data are delivered.

When the contractor has completed 10% of the spatial and attribute data development, the contractor must supply the data to the NCBN data manager for quality control purposes. The data must be delivered in conformance to the spatial data format requirements. Once Network staff have checked the data and found it acceptable, the contractor may continue data development. Once the contractor has completed the work, the NCBN data manager must accept the spatial data, attribute data, and Federal Geographic Data Committee (FGDC) compliant metadata before the job is considered complete.

For each map feature, the estimated horizontal error in meters shall be recorded in the database field "EstHError" (or "Est\_Horz\_Error\_M" for MS Access). Estimated horizontal error is a calculation of the error range associated with a location. The required Federal reporting standard is the radius of a circle of uncertainty, such that the true or theoretical location of the point falls within that circle 95% of the time. For digitized features, the horizontal error is determined by the source map scale and digitizing precision. For GPS locations, most units provide an estimate of positional accuracy that can be used to estimate the horizontal error.

### **V. Metadata**

All spatial data submitted shall include metadata that meets the minimum content standard for digital geo-spatial metadata (FGDC metadata; see <http://geology.usgs.gov/tools/metadata/>). All biological databases submitted shall include metadata that meets the minimum content standard for digital geo-spatial metadata (the Biological Data Profile; see <http://www.nbii.gov/datainfo/metadata/>). The metadata must be parsed with no errors prior to submission using the Metadata Parser (MP) provided by the FDGC. The metadata should be delivered as ASCII text with a .TXT extension, hypertext markup language with an .HTML extension, and standard general markup language with an .SGML extension (<http://geology.usgs.gov/tools/metadata/>).

Specifications for the attributes and database tables attached or linked to the spatial data must be documented in the "Attribute Entity" section of the FGDC metadata and include:

- Field name
- Field description

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- Field format
- Valid values

The NPS Distribution Liability Statement, given below, should be included in the Distribution Information section of the metadata.

*The National Park Service shall not be held liable for improper or incorrect use of the data described and/or contained herein. These data and related graphics, (if available) are not legal documents and are not intended to be used as such. The information contained in these data is dynamic and may change over time. The data are not better than the original sources from which they were derived. It is the responsibility of the data user to use the data appropriately and consistent within the limitations of geospatial data in general and these data in particular. The related graphics are intended to aid the data user in acquiring relevant data; it is not appropriate to use the related graphics as data. The National Park Service gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data. It is strongly recommended that these data are directly acquired from an NPS server and not indirectly through other sources which may have changed the data in some way. Although these data have been processed successfully on a computer system at the National Park Service, no warranty expressed or implied is made regarding the utility of the data on another system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data.*

Several example FGDC-compliant metadata records and browse graphics may be reviewed at [http://www.nps.gov/gis/data\\_info/](http://www.nps.gov/gis/data_info/) for reference. To learn more about getting started with FGDC metadata or using the MetaParser program see <http://geology.usgs.gov/tools/metadata/> or contact your project or data manager. For complete information on FGDC Metadata see <http://www.fgdc.gov/>.

Note: Experienced metadata developers should estimate 4 hours per theme layer for metadata development. If the developer is unfamiliar with FGDC metadata development and guidelines, estimate an additional 20 hours for learning the process.

The Descriptive Document should also include a more easily readable, tabular-formatted data dictionary with the attribute and database tables specifications. The data dictionary should be listed by table and include the field name, field format, field width, and field description with valid values. An entity and relationship diagram should be included for relational tables if applicable.

### **VII. Legend**

If project deliverables include thematic map displays, the corresponding symbology shall be included as an ArcView 3.x legend file (.AVL). Additionally, fields integral to symbolization must be present in the delivered GIS feature attributes. The descriptive document shall include a description of the thematic display and the fields required for symbol rendering.

### **VIII. Linked Documents and Files**

Project documents such as user manuals and detailed descriptions can be linked to map features through “hot linking”. Hot linking allows the user to click a map feature and have a related document open and jump to the chapter associated with an attribute of that map feature. If an associated document is included with the intention of “hot linking” the following is required:

#### **A. MS Word Documents (for conversion to Windows Help Files)**

- The document(s) shall be an MS Word formatted file.
- The document(s) will include a table of contents with separate listings for each "topic" or description that relates to a GIS feature (e.g., extensive textual descriptions of each and every feature of a theme).

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- Include a separate tabular list of which "topics" correspond to each linking field value in the GIS theme (i.e. the key values for linking the document to the GIS).

### **B. HTML Documents**

- The document(s) shall be an HTML formatted file.
- The document(s) will include a table of contents with separate listings and anchors for each "topic" or description that relates to a GIS feature.
- Include a separate tabular list of which "topics" correspond to each linking field value in the GIS theme (i.e. the key values for linking the document to the GIS).

For a more on linking documents to features, see the NPS Theme Manager helpfile "Advanced Theme List Parameters" topic AT <http://science.nature.nps.gov/im/apps/thmmgr/index.htm>.

### **C. Linked Graphics or Digital Photographs**

If any linked digital photographs are included with the data set, they should be in a format that is directly readable in ESRI ArcView 3.x. Image types that can be directly hot linked to a theme in ArcView's Avenue scripting language include .GIF, MacPaint, Microsoft DIB, Sun Raster files, .TIFF, .TIFF/LZW compressed, X-Bitmap, and .XWD. Web browsers and the NPS Graphics Viewer (see <http://science.nature.nps.gov/im/apps/thmmgr/index.htm>) also allow the use of linked .GIF, .JPEG/.JPG and .BMP formats.

Images and graphics shall be organized in a file folder or directory structure that provides a logical hierarchical format. The directory structure recommended by the national I&M Program may be downloaded at <http://science.nature.nps.gov/im/gis/standards.htm>.

Map features with linked graphics/photographs should contain an attribute that records the relative directory location and filename. The suggested field name is "Images" (with "Images2", "Images3", etc. used for multiple fields in a single table). Map layers should have meaningful names that relate to the map theme and its attributes, and digital image filenames be encoded with this value. Any file coding schemes that are used should be documented and included in the Descriptive Document.

## **PROCEDURES**

1. NCBN will receive a complete integrated, geo-referenced spatial/attribute GIS database. All information will be compatible with the park's GIS database and Servicewide GIS data standards.
2. All final maps are to be in AV3 project layout format.
3. Before starting any new GIS spatial/attribute database theme the contractor/cooperator will hold a meeting(s) with the Network staff including the park GIS coordinator, to discuss and design the initial database. Additional guidelines, coding system etc. will be discussed and developed during the meetings. The final design will be in writing and approved by the park.
4. Based on a small sub-sample, approximately 10%, of the data will be entered into the GIS and tested by the cooperator/contractor and the Network.
5. Once #4 has been completed, and approval received from the Network, the database can be completed.
6. The cooperator/contractor will demonstrate that each GIS database works properly before the Network will accept.
7. FGDC compliant metadata files are required.
8. GIS draft databases and metadata should be delivered incrementally. The contractor or cooperator should not wait until all, or most of the GIS database themes are completed before delivering the final drafts for checking and approval.
9. It is the contractor/cooperators responsibility to correct all items pointed out by the Network under items 4, 6, 7 and 8.

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10. The final GIS databases files will be delivered on CD's, two copies, as either Arc Info coverage or Arc View 3.x format. The CD's will also contain the final Metadata files.
11. The Network must first approve distribution of the draft or final digital GIS database themes or maps by the contractor/cooperator to any other person than the park or via the World Wide Web.